

ON THE SOUTH AMERICAN SPECIES OF MYTILIDÆ.

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In studying the Mytilidæ of Brazil and Patagonia, and their relationships with allied species in other parts of the globe, some facts appeared singular, more especially the want of precision in distinction between certain groups of *Mytilus* and *Modiolus*, and the association of *Mytilus edulis* with species belonging to quite a different section.

To Dr. W. H. Dall, in his excellent work on the Tertiary Fauna of Florida (Trans. Wagner Free Inst. Philadelphia, vol. iv, pt. 4, 1898), we owe a new treatment of the divisions and subdivisions of the Mytilidæ. So far as the separation of *Mytilus* and *Modiolus* is concerned, Dall accepts the old views, separating the two by the position of the umbones and the presence or absence of teeth. Neither of these characters is decisive, and there are forms, as, for example, *Modiolus citrinus*, Bolten (= *sulcatus*, Lam.), in which the teeth are much more developed than in many species of *Mytilus*. The same is true of the position of the umbones. These are terminal in *Mytilus edulis*, Linn., and allied forms, non-terminal in many species of *Modiolus*; on the other hand, there are species of *Mytilus* with non-terminal umbones, and of *Modiolus* with terminal beaks. In *Modiolus Trailli*, Rve., the umbones are terminal, and in *M. capax*, Conr., nearly so. These forms offer no difficulty in their classification with the allied species of *Modiolus*, but there are others in which this is not the case. There are a great number of species, both of *Mytilus* and *Modiolus*, in which the umbones are more or less terminal, and situated above the anterior extremity of the shell. This is the case in Mytili belonging to the group of *M. Solisianus*, Orb., *M. minimus*, Poli, etc., and also in the sections *Hormomya*, of *Mytilus*, and *Brachydontes*, of *Modiolus*. In these subgenera the umbones offer no reason for generic separation, nor does the dentition. Comparing *Modiolus citrinus*, Bolt., with *Mytilus Domingensis*, Lam., the position of the umbones is the same in both, but the teeth are more developed in the former species, which is also more solid. Really it would be more natural to completely change the generic position of both. Clessin, in his monograph of the Mytilidæ (Martini & Chemnitz, Conch.-Cab., vol. viii, pt. 3, 1889), figures both species under the name of *Modiola sulcata*, Lam. Of the figures, pl. iv, fig. 10, and pl. xxv, figs. 5, 6, really refer to this species, but pl. xxxi, figs. 9, 10, represent *Mytilus Domingensis*, Lam., a species which he also described (p. 87, pl. xxv, figs. 1, 2) as *Mytilus Orbignyanus*, Clessin. *Mytilus ovalis*, Lam., offers another instructive example. This species is figured by Clessin (pl. xxxiii, figs. 4, 5) as *Modiolus ovalis*, Clessin, and what he describes

as *Mytilus ovalis*, Lam. (pl. xi, figs. 11, 12), belongs to *Modiolus purpuratus*, Lam. Of this last-named species I have specimens received from Dr. R. A. Philippi, while of *Mytilus ovalis*, Lam., I have examples from St. Cruz, Patagonia. Here we have a *Modiolus* described by a specialist as *Mytilus*, and *vice versa*. The same thing has already been pointed out by Tapparone-Canefri, who, in his "Viaggio della Magenta" (1873), p. 247, says that he has seen the Patagonian *Mytilus ovalis*, Lam., in the British Museum as *M. purpuratus*, Lam., which latter, however, is a *Modiolus*. On comparing the two species, I observe that old shells of *M. purpuratus* have the anterior extremity very stout and somewhat deformed, and the anterior muscular impression very pronounced. There are examples of *M. purpuratus* with and without teeth. The teeth are also very variable in *M. ovalis*. Externally both are identical, and in fact, I believe, both only local varieties of the same species. Mörch classifies *M. ovalis* with *Modiolus*.

Mytilus falcatus, Orb., of Patagonia, described by me (Revista Mus. Paulista, tom. ii, p. 106) as *Modiolus*, is figured by Reeve both as *Mytilus* and *Modiolus*; his *Modiolus strigatus* (figs. 33 and 83) and *Mytilus sinuatus* (fig. 16) are synonymous, and, as I believe, identical with *M. falcatus*, Orb., which has the same shape. Many of the Argentine examples are ornamented with the same dark-green markings as *M. falcatus*.

It therefore seems necessary to unite these intermediate forms in one section, and, suppressing the section *Brachydontes* of *Modiolus*, to unite all these radially striate species, having subterminal umbones, with *Mytilus*.

Mytilus is said to be dimyarian, but there are both dimyarian and monomyarian species. Among the *Mytilus* with smooth surface there is a group of closely allied species which are all monomyarian. This section comprises *M. chorus*, Molin., *M. perna*, L., and *M. latus*, Dillwyn. The absence of the anterior adductor is not the only important character of this group; there is also a distinctive disposition of the posterior retractor muscle. In the typical *Mytilus*, as also in *Modiolus*, the posterior retractor has a straight insertion in the shell, forming, with the adductor scar, a figure '6.' In the *Mytilus perna*, Linn., group, the posterior retractor scar is divided into two portions, a separate rounded portion lying on the inner side of its pointed anterior end. This is the byssal muscle, which is well developed in *M. perna*, Linn., and *M. latus*, Lam., but in *M. chorus*, Molin., the separation is sometimes incomplete, and then the impression of the byssal muscle is contiguous to the rest of the posterior retractor scar, as seen, for example, in the figure of *M. meridionalis*, Krauss (Clessin, Mart.-Chemn., pl. viii, fig. 8b). I have examined an animal of *M. meridionalis*, Krauss, in which both portions were quite separate, as they are also in the Chilean *M. chorus*, Molin.

My observations on the muscle scars have been further completed by an examination of the rich collection of mussels, well preserved in alcohol, in the Copenhagen Museum, that were placed at my disposal with great liberality in 1876. The want of the anterior adductor

I noted on *M. perna*, *M. meridionalis*, and *M. hamatus*, Say. The adductor, in its primitive form, is only a modification of the fibres of the united mantle lobes, and its isolation represents a later phylogenetic state, which, perhaps, may be repeated in the ontogeny. Probably the dimyarian state represents the older one, and the reduction and disappearance of the anterior adductor a secondary modification, which may have originated independently in many families. In the genus *Mytilus*, the want of the anterior adductor is not a very important character. *Mytilus Magellanicus*, Chem., from the Magellan Straits, is dimyarian when young, but monomyarian in old specimens, while the New Zealand race seems to be always dimyarian.

Judging from my experience among the radially striate Mytili, monomyarian forms occur only in the section *Aulacomya*, in which Mörch includes *M. Magellanicus*, Chem., and *M. crenatus*, Lam., from South America (this last may be *M. decussatus*, Lam.). To this group *M. hamatus*, Say, with acuminate anterior extremity and terminal umbones, also belongs. On the other hand, the radially striate Mytili of Mörch's section *Hormomya*, as also the striate Modioli, subg. *Brachydontes*, are dimyarians. Since almost all these forms have the anterior extremity obtuse, and the umbones subterminal, situated above or very little behind the anterior extremity, it would seem natural to accept for these species Mörch's subgenus *Hormomya*; but, in opposition to such a division, we must note that *M. exustus*, Linn., has the pointed anterior extremity of *M. hamatus*, and it seems an unnatural grouping to separate them because one is monomyarian and the other dimyarian.

It appears to me, therefore, convenient to separate the two groups of striate *Mytilus*, one with pointed anterior extremities and terminal umbones, the other with blunt anterior ends and subterminal umbones, accepting in a modified sense the subgenera of Mörch.

I would propose the following division for the genera of *Mytilus* and *Modiolus*, premising that since the collections in our Museum do not allow me to make the work complete, the scheme can, therefore, only be taken as affording an exact definition of the conchological characters of the majority of the subgenera.

Genus MYTILUS, Linn.

Shell equivalve, inequilateral, umbones terminal or subterminal. Cardinal teeth few, small, sometimes obsolete. Anterior adductor muscle sometimes wanting.

1. Subgen. EUMYTILUS,¹ n.n. (= *Mytilus*, s.s.).

Surface smooth, or concentrically sculptured, umbones terminal. Type, *M. edulis*, Linn.

¹ I propose to always distinguish those sections which have the same name as the genus by prefixing "eu."³

2. Subgen. CHLOROMYA, Mörch (1853).

Surface smooth, or concentrically sculptured. Anterior adductor absent, byssal muscle separated from the posterior retractor muscle. Colour often yellowish, or green, with darker zigzag markings. Umbones terminal. Type, *M. perna*, Linn.

3. Subgen. TRICHOMYA, n.subg.

Shell radially striate, or smooth with oblique decussate lines, and fibrous-hirsute periostracum. Umbones terminal. Teeth developed, or obsolete. Type, *M. hirsutus*, Lam.

I propose this section for *M. hirsutus*, *M. horridus*, Dkr., and *M. tortus*, Dkr. The last-mentioned is the type of Gray's subgenus *Stavelia*, which I do not accept, because it separates *M. tortus*, which is twisted, from *M. horridus*, its nearest ally, although not twisted.

4. Subgen. MYTILASTER, Monterosato (1884).

Shell smooth, concentrically sculptured, and sometimes exhibiting faint indications of radial sculpture. Dorsal margin denticulate. Umbones subterminal. Type, *M. minimus*, Poli.

M. Solisianus, Orb., which belongs to this section, sometimes shows indications of a very faint radial sculpture, differing very little from *M. minimus*.

5. Subgen. AULACOMYA, Mörch (1853).

Shell strongly radially ribbed, umbones terminal. Anterior adductor often absent. Type, *M. Magellanicus*, Chem.

To this group belong *M. exustus*, Linn., *M. atropurpureus*, Dkr., *M. decussatus*, Lam., *M. hamatus*, Say, etc.

6. Subgen. HORMOMYA, Mörch (1853).

Shell radially sculptured, umbones subterminal. Anterior adductor present. Type, *M. Domingensis*, Lam.

In this section, with the radiate Mytili I place also the radiate Modiolæ with subterminal umbones forming the subgen. *Brachydontes*, Sws., of which *M. citrinus*, Bolten (= *sulcatus*, Lam.), is the type.

Genus MODIOLUS, Lam. (1799).

(= MODIOLA, Lam., 1801.)

Shell equivalve, inequilateral, umbones non-terminal, marginal. Anterior adductor present. Cardinal teeth absent or rudimentary.

1. Subgen. EUMODIOLUS, n.n. (= *Modiolus*, s.s.).

Shell inflated, surface smooth, periostracum not polished, often hirsute. Type, *M. modiolus*, Linn.

2. Subgen. AMYGDALUM, Megerle (1811).

Shell compressed, surface smooth, shining, periostracum polished, not hirsute. Type, *M. pictus*, Lam. (= *arborescens*, Chem.).

Modiella, Monterosato, is said by Dall to be a synonym. Not only *M. luteus*, Fischer, but also *M. politus*, Verill, and other deep-sea species spin a nest like *Lima*.

3. Subgen. GREGARIELLA, Monterosato (1884).

Surface decussate, with central smooth area; shell tumid, periostracum hirsute. Type, *M. Petagna*, Scacchi. *Botulina*, Dall, is a synonym.

Dall appears to me to be right in placing this form in the genus *Modiolus*, instead of *Modiolaria*, as Fischer has done. I observe that in *Mytilus Rodriguezi*, Orb., the radial striæ are also obsolete in the central part of the shell.

4. Subgen. BRACHYDONTES, Swainson (1840).

Surface radially sulcate. Type, *M. demissus*, Dillwyn (= *plicatulus*, Lam.).

M. demissus, on account of its marginal umbones, is a true *Modiolus*, having besides its edentulous hinge. The dentigerous species with subterminal beaks I have united with *Hormomya*.

5. Subgen. BOTULA, Mörch (1853).

Surface deeply, concentrically sulcate; shell inflated, with conspicuously spiral umbones; periostracum polished. Type, *M. cinnamomeus*, Lam.

SPECIES OF MYTILUS AND MODIOLUS, INHABITING THE EASTERN COASTS OF SOUTH AMERICA.

Genus MYTILUS, Linn.

Subgen. EUMYTILUS, Jhr.

1. MYTILUS EDULIS, Linn.

- Mytilus edulis*, Linnæus: Syst. nat., 10th ed. (1758), p. 705; 12th ed. (1766), p. 1157.
- „ *Platensis*, Orbigny: Voy. Amér. mérid., tom. v [1846], p. 645, pl. lxxxv, figs. 3, 4.
- „ *Patagonicus*, Orbigny: t.c., p. 646, pl. lxxxv, figs. 12, 13.
- „ *Platensis*, Orb.: Hidalgo, Mol. Viaje Pacífico, pt. ii (1869), p. 53, pl. iii, fig. 5.
- „ *Fischerianus*, Tapparone-Canefri: Zool. Viag. Magenta, Malac. (1874), p. 138, or Mem. Accad. Sci. Torino, ser. II, tom. xxviii (1876), p. 242, pl. iv, fig. 1.
- „ *edulis*, Linn.: E. A. Smith, Phil. Trans., vol. clxviii (1879), p. 189.

- Mytilus canaliculus*, Hanley : Dall, Nautilus, vol. v (1891), p. 43 ;
vi (1893), p. 111.
,, *edulis*, Linn. : Pilsbry, Nautilus, vol. xi (1897), p. 9.
,, *canaliculus*, Hanley : Pilsbry, Nautilus, vol. xi (1897), p. 9.
,, *Fischerianus*, Tapparone-Canefri : E. A. Smith, Rep. Zool. Coll.
Alert (1884), p. 44.
,, *edulis*, Linn. : Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 101.

The examples from Montevideo are small and blue; from the Patagonian coast we have much larger forms, which vary in colour. The younger shells are yellowish, the older ones variable in colour, from yellowish to greenish and to blue. There is no reason for founding two species on these differences, as D'Orbigny and other authors have done. I observe that *M. Patagonicus*, Clessin (Conch.-Cab., p. 82, pl. i, figs. 5, 6), is not the species of D'Orbigny, as Clessin believes, but a variety of *M. angustanus*, Lam., with which *M. sinister*, Dkr., seems synonymous.

M. canaliculus, Hanley, which seems to be only a variety of the European *M. edulis*, has been considered by Crosse as a synonym of *M. chorus*. The confounding of *M. edulis* with *M. chorus* is very noticeable in the literature, as I shall point out when treating of this species. The Kerguelen species would be *M. edulis* according to E. A. Smith, *M. chorus* according to Crosse; the New Zealand *M. edulis* is also doubtful in this sense.

M. edulis occurs from the Magellan Straits to Montevideo, Rio Grande do Sul, and also St. Catharina, but no farther northwards. On the Chilian coast it is known as *M. Chilensis*, Hupé, *M. Chiloensis* (Phil.), Reeve, *M. obesus*, Dkr. (*nec* Reeve?), and as *M. trossulus*, Gld., in California.

M. meridionalis, Krauss, considered by Sowerby to be a variety of *M. edulis*, is a synonym for *M. chorus*, and it would therefore seem that *M. edulis* does not occur at South Africa.

M. Hupeanus, Mabille & Rochebrune, is said by Dautzenberg (Act. Soc. Sci. Chili, vi, 1896, p. lxxv) to be *M. Chilensis*, Hupé. *M. infumatus*, Mab. & Rochebr., is not recognizable in the absence of typical specimens. Both are Magellanic species.

2. MYTILUS STRIGATUS, Hanley (1844).

- Modiola strigata*, Hanley : Proc. Zool. Soc., 1844, p. 15.
,, ,, Hanley : Reeve, Conch. Icon., vol. x (1858), figs. 33
and 83.
,, *fulcata*, Orb. : Jhering, Rev. Mus. Paulista, vol. ii (1897),
p. 106.
Mytilus sinuatus (Dunker MS.), Reeve : Conch. Icon., vol. x (1858),
fig. 16.
,, *fulcatus*, Orbigny : Voy. Amér. mérid., tom v [1846], p. 645,
pl. lxxxiv, figs. 38, 39 (as *M. Charruanus*!).
Modiola arcuatula, Hanley : Clessin (*nec* Hanley), Conch.-Cab., 2nd ed.,
p. 101 [1887], pl. xxx, figs. 8, 9.

I have examples of this singular species from Rio de Janeiro, Santos, St. Catharina, Montevideo, and Cap S. Antonio. The Brazilian shells are unicolorous, or rarely exhibit markings; the Argentine ones have zigzag markings on the posterior half of the shell, like the Philippine species figured by Reeve. The teeth are sometimes developed, sometimes obsolete, for which reason they have been classified both with *Mytilus* and *Modiolus*.

3. MYTILUS SOLISIANUS, Orbigny (1846).

- Mytilus Solisianus*, Orbigny: Voy. Amér. mérid., tom. v [1846], p. 646, pl. lxxxv, figs. 5-7.
 ,, *Lavalleanus*, Orb.: Reeve (*nec* Orb.), Conch. Icon., vol. x (1858), fig. 54.
 ,, *Solisianus*, Orb.: Hidalgo, Mol. Viaj. Pacífico, pt. ii (1869), p. 54.
 ,, *Janeirensis*, Frauenfeld: Reise Novara Moll. (1867), p. 16.
 ,, *exiguus*, Dunker: Jahrb. Deutsch. Malak. Ges., Bd. ii (1875), p. 251.
 ,, *Solisianus*, Orb.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 99.
 ,, *exiguus*, Dunker: Dall, Nautilus, vol. vi (1893), p. 110.

Young specimens have a delicate radiate sculpture, which, however, is not at all constant, and never present in the adult shells. It is, therefore, not justifiable to separate *M. Solisianus* from *M. minimus*, Poli. Both have the same form and dimensions, while the dorsal margin behind the ligament is denticulate in both. *M. atratus*, Lischke, which is very similar in form, has the dorsal margin smooth. I believe that *M. Solisianus* is nothing but a large variety of *M. minimus*, Poli — my largest example is 15 mm. in length — having sometimes five radial striæ when young. I am obliged to Dr. E. von Martens for verifying the identity of *M. Solisianus* with Dunker's types of *M. exiguus*, and to Dr. Sturany for having given me typical examples of Dunker's *M. Janeirensis*.

M. Solisianus occurs from Maldonado to the West Indies, and Mexico (Dunker).

Subgen. CHLOROMYA, Mörch.

4. MYTILUS PERNA, Linn.

- Mya perna*, Linnaeus: Syst. nat., 10th ed. (1758), p. 671; 12th ed. (1766), p. 1113.
Mytilus perna, Linn.: Reeve, Conch. Icon., vol. x (1858), sp. 23.
 ,, ,, Linn.: Dunker, Jahrb. Deutsch. Malak. Ges., Bd. ii (1875), p. 250.
 ,, *elongatus*, Orbigny: Voy. Amér. mérid., tom. v [1846], p. 643.
 ,, *afer*, Gmelin: Hidalgo, Mol. Viaj. Pacífico, pt. ii (1869), p. 50.
 ,, *perna*, Linn.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 93.
 ,, ,, Linn.: Clessin, Conch.-Cab., 2nd ed., p. 57 (1887), pl. xiii, fig. 9.

This is a Brazilian species, occurring from Rio de Janeiro to St. Catharina; the shell, sometimes elongate, sometimes triangular, always shows the following characteristics. The zigzag marks, developed or absent, as in *M. latus*, etc. The largest specimens are 80–90 mm. long, while the examples of *M. elongatus*, of 130–140 mm., figured by Clessin (Conch.-Cab., pl. iii, fig. 1), refer to *M. latus*. The shell is thin. The *M. perna* from South Africa is a more solid shell, with porcellaneous nacre, perhaps only a variety of *M. afer*, Gm., or *M. pictus*, Born, which is a larger and more triangular form. *M. latus*, Dillw., from New Zealand, is a very closely allied species, of which *M. smaragdinus*, Chem., is a variety.

On the eastern coasts of South America we have only one species belonging to the *Chloromya* group, which I hold to be distinct from the *M. perna* of South Africa.

On the South African coast the *Chloromya* section is represented by *M. chorus*, Molin. (= *M. meridionalis*, Krauss, *M. unguatus*, Rve.), *M. perna*, Linn., *M. pictus*, Born. The last-named occurs also at Algiers, Guinea, etc., and I do not believe Clessin's statement that *M. smaragdinus*, Chem. (an Indian Ocean species), occurs on the Guinea coast, to be correct. The New Zealand representative of this subgenus is *M. latus*, Dillw. (= *M. cuneiformis*, Rve.?), a point which must be verified, in the event of the species occurring also on the Chilian coast. The synonymy of *M. perna*, *M. elongatus*, etc., which depends upon the habitat of the respective types, should likewise be investigated.

Subgen. AULACOMYA.

5. MYTILUS MAGELLANICUS, Chem.

- Mytilus Magellanicus*, Chemnitz: Conch.-Cab., vol. viii (1785), p. 162, pl. lxxxiii, figs. 742–3.
- „ „ Chem.: Reeve, Conch. Icon., vol. x (1858), sp. 22.
- „ „ Chem.: Orbigny, Voy. Amér. mérid., tom. v [1846], p. 647.
- „ „ Chem.: Clessin, Conch.-Cab., 2nd ed., p. 54 (1887), pl. iii, figs. 8, 9; pl. vii, fig. 7.
- „ „ Chem.: Martens, Jahrb. Deutsch. Malak. Ges., Bd. i (1874), p. 124.
- „ „ Chem.: Martens, Mal. Blätt. (1872), p. 8.
- „ „ Chem.: E. A. Smith, Phil. Trans., vol. clxviii (1879), p. 188.
- „ „ Chem.: Tapparone-Canefri, Zool. Viag. Magenta, Malac. (1874), p. 140, or Mem. Accad. Sci. Torino, ser. II, tom. xxviii (1876), p. 244.

This large, well-known species occurs on the eastern side of Patagonia to the Rio Negro, and on the western, according to Philippi, to Caldera; the species also occurs in Southern Africa, New Zealand, and at the Fiji, Auckland, Campbell and Kerguelen Islands. On the northern shores of Chili and on the Peruvian coast, it is replaced by

M. decussatus, Lam. (= *M. Americanus*, Orb., *M. Orbignyanus*, Hupé, *M. erenatus* (Lam.), Mörch), considered by some authors to comprise two species, but on this point I am unable to speak.

6. MYTILUS EXUSTUS, Linn.

- Mytilus exustus*, Linnæus: Syst. nat., 10th ed. (1758), p. 705; 12th ed. (1766), p. 1156.
 ,, ,, Linn.: Lamarek, Anim. sans Vert., vol. vi (1819), p. 121.
 ,, ,, Lam.: Reeve, Conch. Icon., vol. x (1858), fig. 10.
 ,, ,, Lam.: Clessin, Conch.-Cab., 2nd ed. (1887), p. 42, pl. xvi, figs. 7, 8.
 ,, *Domingensis*, Lam.: Clessin, loc. cit., p. 79, pl. xi, figs. 15, 16.
 ,, *exustus* (Lam.), Reeve: Smith, Journ. Linn. Soc., vol. xx (1890), p. 499.
 ,, *atropurpureus*, Dunker: Clessin, loc. cit., p. 32, pl. xi, figs. 1, 2.
 ,, *exustus*, Lam.: Dall, Trans. Wagner Inst., vol. iv, p. 788; Nautilus, vol. x (1897), p. 123.
 ,, *Domingensis*, Lam.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 96.
 ,, *cubitus*, Say: Clessin, loc. cit., p. 43, pl. xvii, figs. 5, 6.
 ,, *Adamsianus*, Dunker: Reeve, loc. cit., sp. 55.

This is a solid shell, with terminal umbones, strongly bifurcate, ribbed, with yellow periostracum, sometimes marked with purplish-brown zones and spots. D'Orbigny has not recorded this species, which does not occur in Southern Brazil, his *M. Domingensis* belonging to the following species. The present species occurs from the West Indies to Pernambuco (Smith) and Bahia (Jhering). It seems that it exists also on the West African coast, but I have not the necessary material for studying the question with relation to the allied African and Indian species. The Panama representative is *M. Adamsianus*, Dkr., which does not appear to be a distinct species.

Subgen. HORMOMYA.

7. MYTILUS DOMINGENSIS, Lam.

- Mytilus Domingensis*, Lamarek: Anim. sans Vert., vol. vi (1819), p. 122.
 ,, ,, Lam.: Orbigny, in Sagra's Hist. nat. Cuba, Moll., vol. ii [1846?], p. 328; Voy. Amér. mérid., tom. v [1846], p. 645.
 ,, ,, Lam.: Hidalgo, Mol. Viaj. Pacífico, pt. ii (1869), p. 54, pl. ii, fig. 6.
 ,, *Orbignyanus*, Clessin: Conch.-Cab., 2nd ed., p. 87 (1887), pl. xxv, figs. 1, 2.
Modiola sulcata, Lam.: Clessin, loc. cit., p. 123, pl. xxxi, figs. 9, 10.
Mytilus atropurpureus (Dunker MS.), Reeve: Conch. Icon., vol. x (1858), fig. 11.

- Modiola Morrisi*, Dunker: Reeve, loc. cit., sp. 38.
 „ *Muelleri*, Dunker: Jahrb. Deutsch. Malak. Ges., Bd. ii (1875),
 p. 250.
 „ *Muelleri*, Jhering: Rev. Mus. Paulista, vol. ii (1897), p. 99,
 figs. 3, 4.
 „ *Magellanicus*, Reeve: Dall, Nautilus, vol. v (1891), p. 43.
 „ *rostratus*, Dunker (*ex* Reeve): Tapparone-Canefri, Zool. Viag.
 Magenta, Malac. (1874), p. 143, or Mem.
 Accad. Sci. Torino, ser. II, tom. xxviii (1876),
 p. 247.

Common at Montevideo, St. Catharina, etc., ranging to the West Indies, and it seems also to Western Africa. This is a thin shell, with feeble, somewhat flattened, radiate ribs, and purplish-dark periostracum. *M. rostratus*, which Tapparone-Canefri believed to be the same species, is in its exterior aspect identical, but differs internally, being a *Septifer*.

8. MYTILUS DARWINIANUS, Orbigny.

- Mytilus Darwinianus*, Orbigny: Voy. Amér. mérid., tom. v [1846],
 p. 643, pl. lxxxiv, figs. 30-33.
 „ „ Orbigny: Pilsbry, Nautilus, vol. xi (1897), p. 9.
 „ „ Orbigny: Jhering, Rev. Mus. Paulista, vol. ii
 (1897), p. 98.
 „ *Lavalleanus*, Orbigny: Clessin, Conch.-Cab., 2nd ed., p. 80
 (1887), pl. xi, figs. 7, 8.

This species, which is of small dimensions, is characterized by the projecting angle of its dorsal margin, its broad form, and the numerous transverse teeth behind the ligament. The species occurs from the Rio Negro to Rio de Janeiro. Rochebrune & Mabile record it from the Magellan Straits,¹ but I believe that this may more likely prove to be *M. ovalis*, Lam., since I have this species from St. Cruz, and have seen no examples of *M. Darwinianus* from St. Cruz nor the Magellan Straits. If, as I believe, *M. Lavalleanus*, Clessin, is a synonym for this species, it ranges to the Antilles.

9. MYTILUS LAVALLEANUS, Orbigny.

- Mytilus Lavalleanus*, Orbigny: in Sagra's Hist. nat. Cuba, Moll.,
 vol. ii [1846?], p. 328, pl. xxviii, figs. 3-5.
 „ *cubitus*, Say: Reeve, Conch. Icon., vol. x (1858), sp. 57.
 ? „ *Charpentieri*, Dunker: Clessin, Conch.-Cab., 2nd ed., p. 33
 (1887), pl. viii, fig. 3.

M. Lavalleanus, Orb., seems to be a more tumid variety of *M. exustus*, Linn. The *M. Lavalleanus* of Reeve is *M. Solisianus*; that of Clessin

¹ Mission Sci. Cap Horn, tom. vi, Moll. (1889), p. 119.

is *M. Darwinianus*. Probably *M. Charpentieri* (Dkr.) Clessin, from Western Africa, is the same; perhaps also *M. Charpentieri*, Reeve, which, however, has more resemblance to *M. granulatus*, Hanley. Possibly *M. excisus*, Rve., and *M. ustulatus*, Rve., are identical. The present is an Antillean species.

10. MYTILUS RODRIGUEZII, Orb.

Mytilus Rodriguezii, Orb.: Voy. Amér. mérid., tom. v [1846], p. 646, pl. lxxxv, figs. 9, 10.

Modiola Martensi, Jhering: Rev. Mus. Paulista, vol. ii (1897), p. 104, fig. 6.

Modiola sulcata, Dall: Nautilus, vol. v (1891), p. 43.

I have this species from Puerto Madryn and Puerto Cameron, on the Patagonian coast, from Cap S. Antonio, etc., on the Argentine coast, and from Rio Grande do Sul. The Patagonian form var. *Madrynensis*, mihi, is smaller and darker: the Rio Grande do Sul form is somewhat flattened, with the dorsal half reddish-brown, and was originally described by me as *M. Martensi*.

Modiolus citrinus, Bolten (= *M. sulcatus*, Lam., = *Mytilus exustus*, Orbigny, in Sagra's Cuba, ii, p. 329, pl. xxviii, figs. 6, 7), to which Dall referred the Rio Grande do Sul specimens, is an Antillean species not met with in Brazil. Clessin's *M. Paetelianus* is a synonym for *M. citrinus*, and said by him to occur also at Australia and the Philippines.

11. MYTILUS OVALIS, Lam.

Mytilus oralis, Lamarck: Anim. sans Vert., vol. vi (1819), p. 121.

„ „ Lam.: Reeve, Conch. Icon., vol. x (1858), sp. 14.

„ „ Lam.: Hidalgo, Mol. Viaj. Pacífico, pt. ii (1869), p. 48, pl. ii, fig. 7.

? „ *variabilis*, Krauss: Südafr. Moll. (1848), p. 25, pl. ii, fig. 5.

? „ *Senegalensis*, Lam.: Clessin, Conch.-Cab., 2nd ed., p. 38 (1887), pl. xi, figs. 3, 4.

„ *oralis*, Lam.: Tapparone-Canefri, Zool. Viag. Magenta, Malac. (1874), p. 143, or Mem. Accad. Sci. Torino, ser. II, tom. xxviii (1876), p. 247.

Modiola oralis, Lam.: Clessin, loc. cit., p. 128 (1888), pl. xxxiii, figs. 4, 5.

? *Aulacomya Darwiniana*, Orb.: Rochebrune & Mabille, Mission Sci. Cap Horn, tom. vi, Moll. (1889), p. 119.

I have already treated (ante, p. 85) of the relationship between this species and *Modiolus purpuratus*. Care must also be taken not to confuse it with young shells of *Mytilus Magellanicus*, since the two forms live together. The young shell of the latter species is much broader, with the radial ribs strong and the adductor scars very feeble. In shells of *M. oralis*, the radial sculpture is at first feeble, becoming successively stronger, and the adductor scars are very pronounced.

This Chilean species occurs in the Magellanic region and on the Atlantic side at St. Cruz. I believe the South African *M. variabilis*, Krauss, to be the same.

Genus MODIOLUS, Lam.

Subgen. EUMODIOLUS.

12. MODIOLUS TULIPA, Lam.

- Modiola tulipa*, Lamarek: Anim. sans Vert., vol. vi (1819), p. 111.
 ,, ,, Lam.: Reeve, Conch. Icon., vol. x (1858), figs. 5 and 15.
 ,, *albicosta*, Lam.: Reeve, t.c., fig. 7.
Mytilus Americanus, Favart d'Herbigny: Orbigny, in Sagra's Hist. nat. Cuba, Moll., vol. ii [1846?], p. 329.
Modiola capax, Conrad: Dunker (*nec* Conrad), Jahrb. Deutsch. Malak. Ges., Bd. ii (1875), p. 252.
 ,, *albicosta*, Lam.: Clessin, Conch.-Cab., 2nd ed., p. 96 (1887), pl. v, fig. 5.
 ,, *tulipa*, Lam.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 103.

Of this well-known species I have examples from the coast of S. Paulo and Bahia, and Dunker obtained it from St. Catharina. *M. capax*, which Dunker believed to be the same, is a Pacific variety of *M. modiolus*. Clessin has not given a good figure of this species, his pl. xxxii, figs. 1, 2, referring to *M. modiolus*, and pl. v, fig. 4, to *M. auriculatus*, Krauss. I cannot form any idea as to the relationship of this species to *M. albicostus*, Lam. I have received from the West Indies as *M. Americanus*, Fav. d'Herb., a smaller, slender form, with concentric grooves and striæ, which has the ligament much longer than *M. tulipa*.

I observe that *Modiolus modiolus*, Linn., does not occur on the Brazilian coasts.

13. MODIOLUS BRASILIENSIS, Chem.

- Mytilus Guyanensis*, Orbigny: Voy. Amér. mérid., tom. v [1846], p. 644.
Modiola Brasiliensis, Chem.: Reeve, Conch. Icon., vol. x (1858), figs. 17 and 31.
 ,, ,, Chem.: Clessin, Conch.-Cab., 2nd ed., p. 110 (1887), pl. i, figs. 7-8c; pl. xxvi, figs. 6, 7.
 ,, ,, Chem.: Hidalgo, Mol. Viaj. Pacífico, pt. ii (1869), p. 56, pl. iii, fig. 7.
 ,, ,, Chem.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 102, fig. 5.
 ,, *sinuosa*, King: Zool. Journ., vol. v (1831), p. 337 (Santos).

The specimens from the coast of S. Paulo are of a uniform brown colour, sometimes incurved, owing to deformity; those from Rio de Janeiro, Bahia, and Pernambuco have a bright green band.

The species occurs from S. Paulo to Guiana, and also at Panama and California.

Subgen. AMYGDALUM.

14. MODIOLUS PICTUS, Lam.

- Modiola picta*, Lamarek: Anim. sans Vert., vol. vi (1819), p. 112.
 „ *arborescens*, Chem.: Reeve, Conch. Icon., vol. x (1858), fig. 30.
 „ „ Chem.: Clessin, Conch.-Cab., 2nd ed., p. 100 (1887), pl. xxix, fig. 10.
 „ „ Chem.: Jhering, Rev. Mus. Paulista, vol. ii (1897), p. 105.

This is a West Indian species said by Mörch to occur also on the Brazilian coast; but if so, it will be to the north of Pernambuco.

GEOGRAPHICAL DISTRIBUTION.

Of other genera of Mytilidæ on the coast of Brazil and Argentina, the following species occur:—*Lithophaga nigra*, Orb. (= *L. Carabæa*, and *L. Antillarum*, Phil.), is said by Dall to occur at Rio de Janeiro. *Lithophaga Antillarum*, Orb., of which *L. straminea*, Reeve, seems to be a synonym, and *L. cristata*, Dillwyn, have not been observed hitherto southward of the West Indies. *Lithophaga bisulcata*, Orb., occurs from South Carolina to St. Catharina, where, as Prof. von Martens informs me, Fritz Müller collected examples sent to the Berlin Museum. I obtained the species at S. Sebastiano, where it bores into corals. *L. Patagonica*, I have from Puerto Madryn, Patagonia; Rochebrune & Mabile obtained it from the Magellan Straits. *Modiolaria opifera*, Say, I have from Bahia; Dunker obtained it from St. Catharina. *Modiolaria viator*, Orb., occurring from Patagonia to the Antilles, I have from S. Sebastiano. From Cap S. Antonio, Argentina, I have another Antillean species of wide distribution, *Crenella divaricata*, Orb., which also occurs at Panama.

The following is the complete list of the Mytilidæ occurring between the Magellan Straits and the West Indies, on the Atlantic shores of South America, the species marked with an * occurring also in the Antillean regions:—

- Mytilus edulis*, Linn.: Magellan Straits to Rio Grande do Sul and St. Catharina; Chili; New Zealand; Northern Hemisphere.
 * „ *strigatus*, Hanley: Argentina to Rio de Janeiro; Philippines.
 * „ *Solisianus*, Orb.: Uruguay to the West Indies.
 „ *perna*, Linn.: St. Catharina to Rio de Janeiro.
 „ *Magellanicus*, Chem.: Magellan Straits to Rio Negro; Chili; New Zealand; Kerguelen; South Africa; Fiji.

- * *Mytilus exustus*, Linn.: Bahia to the West Indies.
 * „ *Domingensis*, Lam.: Uruguay to the West Indies.
 „ *Darwinianus*, Orb.: Rio Negro to Rio de Janeiro.
 „ *Rodriguezi*, Orb.: Patagonia to Rio Grande do Sul.
 „ *oralis*, Lam.: Magellan Straits to St. Cruz; Chili.
 * *Modiolus tulipa*, Lam.: St. Catharina to the West Indies.
 * „ *Brasiliensis*, Chem.: S Paulo to Guiana; Panama; California.
 * „ *pictus*, Lam.: North Brazil to Antilles.
 * *Lithophaga nigra*, Orb.: Rio de Janeiro to Carolina.
 * „ *bisulcata*, Orb.: St. Catharina to Carolina.
 * „ *Patagonica*, Orb.: Magellan Straits to Rio Negro.
Modiolaria Chenuana, Orb.: "Brazil."
 * „ *opifex*, Say: St. Catharina to Carolina.
 * „ *viator*, Orb.: Patagonia to the West Indies.
 * *Crenella divaricata*, Orb.: Argentina to Florida; California.

Of these twenty species eleven are Antillean, that extend to Northern Brazil, Rio de Janeiro, St. Catharina, etc., or even to Patagonia (Rio Negro), but no single species is common to the Antillean and the Magellanic districts. This is not astonishing, since the Brazilian coast fauna is essentially a depauperate Antillean one. In many families the Brazilian species are also all common to the West Indies. All the species of *Arca*, *Cardium*, etc., occur both on the Guiana coast and in the Antillean Ocean. The special feature of interest about the Mytilidæ is that a large number of the species are not found in the West Indies at all.

Among these are the Magellanic forms, *Mytilus edulis*, *M. Magellanicus*, *M. oralis*, and *Lithophaga Patagonica*. The relationship of the last-mentioned species is not evident. My specimens have two somewhat pronounced lines running down from the umbones, that indicate affinities with *L. bisulcata*, Orb. If these lines were to completely disappear, the shell would be indistinguishable from *L. cristata*. It seems, therefore, that *L. Patagonica* is a variety of one of the Antillean species.

The three species of *Mytilus*, on the contrary, are Antarctic forms, distributed from the Magellan Straits on both sides of Patagonia. They are species of wide distribution, that may have attained their present distribution in times when the Antarctic lands were more connected than they are to-day. *Mytilus edulis* is also an Arctic species, and apparently occurs along the western coast of America. This would suggest that the species may have migrated along the west coast of America to the Magellan Straits, and then wandered upwards on the Atlantic side to southern Brazil; but of all the species which seem to have reached the Magellanic province by southward migration, such as *Monoceras concholepas*, etc., not one has wandered to eastern Patagonia; and the occurrence of *M. edulis* cannot well be explained on different grounds from the rest. It must be remembered that *M. edulis* and *M. Magellanicus* occur not only on the Patagonian coast, but also at Kerguelen, New Zealand, etc. There is not sufficient paleontological material available at present to enable

an exact idea to be formed on the relationships between the Arctic and Antarctic representatives of *M. edulis*. It must also be observed that *M. Solisianus* is another analogous species, being represented in Europe by *M. minimus*. Species of such wide and disconnected distribution may have had a much wider range in former times, and subsequently have become extinct in the tropical regions. Still, the geographical distribution of these species, as well as of *M. chorus* and others, cannot be understood without recurring to the different geographical conditions of the Antarctic region in Tertiary times.

Turning to the other species of our list, *Modiolaria Chenuana*, like *Mytilus Rodriguezi*, seems to be restricted to the South Brazilian and Argentine coast, while *M. Darwinianus* may be a variety of *M. exustus*. There remain, however, two species having a highly interesting distribution, *M. strigatus* and *M. perna*. As I have already said, the singular *M. fulcatus*, Orb., does not differ in form and coloration from the Philippine species *M. strigatus*. On the other hand, *M. perna* has a very restricted range on the Brazilian coast. There is no other species of the subgenus *Chloromya* northward of Rio de Janeiro; and since the distribution of the subgenus is restricted to the Southern Hemisphere, no species being proper to the Northern, and since the same species, or a closely allied one, occurs in South Africa, we must conclude that the Brazilian species came from the Antarctic region in Tertiary times. A study of the Tertiary fauna of Patagonia proves there was a warmer climate then. The pampean deposits of La Plata, moreover, include species of *Arca*, *Purpura*, *Littorina*, etc., which do not now occur on the Argentine coast. I believe that the distribution of *M. strigatus* can be similarly explained.

All these facts impart a special interest to the study of these South American Mytilidæ, and it is, therefore, very desirable to obtain further material in order to work out the complete synonymy and distribution of these species, and their relationships with other allied forms in different parts of the globe.

MALACOLOGICAL SOCIETY OF LONDON.

INCOME AND EXPENDITURE FOR THE YEAR ENDING 31st DECEMBER, 1899.

	£	s.	d.	Cr.	£	s.	d.
To Balance from last year	26	18	5	By Cost of "Proceedings"—			
Annual Subscriptions—				Printing and Postage	£70	17	3
Ordinary Members	£38	6	6	Illustrating	17	2	0
Corresponding Members	14	18	6		—	—	—
Annual Subscriptions in arrear—	53	5	0	Printing Circulars, etc.			87
Ordinary Members	£4	4	0	Postage and Stationery			2
Corresponding Members	4	10	0	Gratuities to Attendants, etc.			12
Annual Subscriptions in advance—	8	14	0				6
Ordinary Members	£1	11	6				5
Corresponding Members	2	2	0				17
Entrance Fees	3	13	6				3
Donations for Illustrations	4	4	0				2
Advertisements in "Proceedings"	1	10	0				12
Sale of "Proceedings"	2	5	0				6
Dividends on £50 Metropolitan 2½% Stock	21	8	6				3
Balance in hand	24	4	5				0
	£123	3	5				—
	£123	3	5				—

We have this day examined the accounts of the Treasurer of the Malacological Society of London, and we find the above statement to be correct.

GEO. F. HARRIS, Hon. Treasurer.
January 13th, 1900.

(Signed) { HENRY WOODWARD.
 { WALTER CROUCH.